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EXPERIMENTAL STUDIES  
IN  
ULTRAVIOLET SOLID STATE SPECTROSCOPY

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## Research Accomplished

During the present reporting period the research has involved three main areas as detailed below:

### (1) Reflection spectra

Spectra of KI, NaCl and KCl at 80°K in the spectral region 5-12 eV were obtained.<sup>1</sup> The measurements were performed with a recently completed low temperature vacuum reflectometer which operates routinely near  $10^{-9}$  torr. Results of some of this work appear in the enclosed publication preprint. The spectra show new fine structure near the region corresponding to the onset of interband transitions and have been useful in clarifying the situation concerning higher exciton states in KI. An asymmetric sharpening of exciton peaks which straddle a direct scattering threshold was observed. This effect was predicted by Phillips<sup>2</sup> and an analysis involving line broadening from both electron scattering and phonons may be used to extract information concerning the electron scattering broadening from the experimental spectra.

Low temperature reflection spectra (80°K) of type I and IIa diamond, in the region 5-12 eV, have been obtained. Preliminary analysis of the data indicates fine structure in the weak 7 eV peak but otherwise the spectrum duplicates the previous room temperature results as expected from the large Debye temperature of diamond.

## (2) Luminescence

A survey of low temperature luminescence excited by ultraviolet radiation in the exciton absorption bands of several alkali halides has been completed. Crystals of NaF, NaCl, NaI, KF, KCl and KI obtained from several different sources were used to obtain both excitation and emission spectra at 80°K. Of these crystals only NaCl and KI showed the strong luminescence characteristic of intrinsic electron recombination.<sup>1</sup> In these materials, new absorption fine structure observed in the excitation spectrum has been interpreted as due to the  $2s \Gamma_{3/2}$  exciton state.<sup>3</sup> The mechanisms responsible for the efficient quenching of the recombination process in the other crystals is currently being studied.

## (3) Ultraviolet polarizer

An improved uv polarizer of the pile-of-plates type, employing LiF plates, has been constructed and tested. The polarizer is designed to facilitate easy mounting on each of the monochromators being used in the research thus converting them into polarizing monochromators over the spectral range 2000 - 1000 Å. The design allows easy interchange of polarizing plates and continuous angular settings to  $\pm \frac{1}{2}$  degree. These features allow immediate application of the polarizer to:

- (a) direct evaluation of the optical parameters of isotropic materials in the ultraviolet using a technique independent of Kramers-Kronig inversion.
- (b) studies of the polarization dependence of the ultraviolet absorption spectra of non-cubic crystals.
- (c) ultraviolet luminescent studies employing both polarized excitation and emission spectra.

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